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Local electromechanical properties of barium strontium titanate based glass-ceramics

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Glass-ceramics comprising of ferroelectric grains surrounded by glass matrix are of significant interest for power electronics applications due to enhanced energy storage capabilities [1]. Barium strontium titanate (BST) ferroelectric glass-ceramics is one of the most promising candidates due to dielectric constants and high breakdown strengths [2,3]. In spite of macroscopic properties of BST ceramics are known, there is still lack of studies on local distribution of ferroelectric phase and its evolution during ceramics cycling.

We have studied microstructure, surface morphology and local piezoelectric activity of $(Ba_{0.25},Sr_{0.75})TiO_3$ based glass-ceramics with different amount of Mn additive (from 0 to 0.5%) prepared from melted and quenched mixed powders. The as-quenched was annealed and subjected to a controlled crystallization in air for 2h in temperature range from 850 to 950°C.

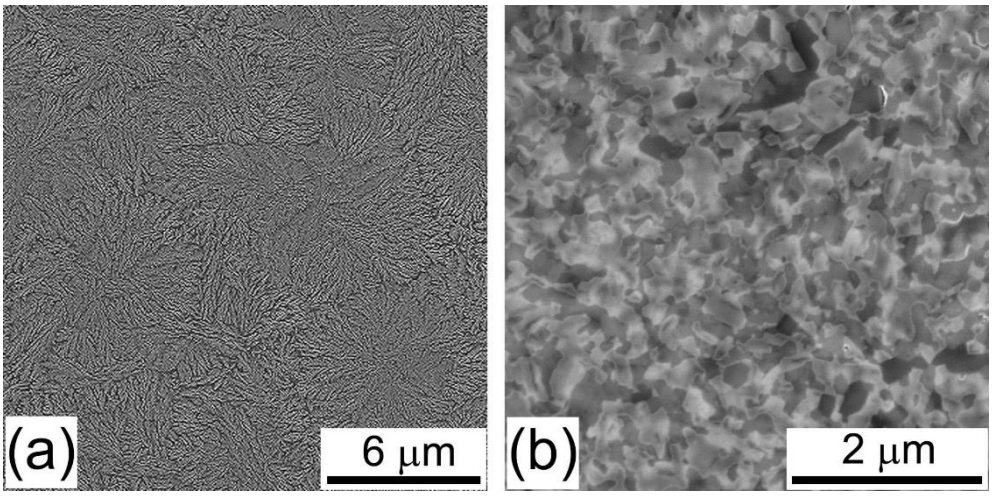

Figure 1. Microstructure of BST ceramics, annealed at: (a) 850°C, (b) 950°C.

Scanning electron microscopy studies of microstructure demonstrated the formation of the dendrite-like aggregates with sizes about 3-6 μm in ceramics annealed at 850°C and conventional faceted-shape grains with about 50-200 nm typical size in ceramics annealed at 950°C. Angle-resolved piezoresponse force microscopy measurements revealed absence of piezoresponse in dendrite-like aggregates, while faceted-shape randomly oriented grains were piezoelectrically active. The calculated fraction of piezoelectrically active phase was about 0.5. The individual piezoelectrically active grains mainly are in single-domain state and we couldn't realize tip-induced domain switching with applied voltage up to 200 V, which can be attributed to effective bulk screening. The observed effects emphasize the key role of microstructure in polarization reversal and dielectric properties of glass-ceramics.

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1. Q. Tan, P. Irwin, Y. Cao, *IEEJ Trans. FM* **126**, 1153 (2006).
2. Y. Zhang, J.J. Huang, T. Ma, X.R. Wang, C. Deng, X. Dai, *J. Am. Ceram. Soc*. **94**, 1805 (2011).
3. X. Wang, Y. Zhang, I. Baturin, T. Liang, *Mat. Res. Bull*. **48**, 3817 (2013).